Epidemiological and Social Dimension of Arsenic Toxicity: A Case Study of West Bengal, India

Background and importance of the study

The World Health Organization (WHO) recognizes arsenic as one of the most serious inorganic contaminant with toxic properties in drinking water derived from groundwater on a worldwide basis (WHO 1981). The International Agency for Research on Cancer (IARC) has classified arsenic as a Group 1 human carcinogen (IARC 2001). While earlier maximum allowable concentrations recommended by WHO for arsenic in drinking water were higher, in 1993 the provisional WHO guideline value was reduced to ≤0.01 milligram/Litre (mg/L) based on concerns regarding its carcinogenicity in humans (WHO 2004). However, a number of countries, including India, use arsenic level ≤0.05 mg/L as acceptable, which corresponds to the provisional WHO guideline value before 1993. In recent years both the WHO guideline value and the current national standards for arsenic have been found to be frequently exceeded in drinking water sources, with Bangladesh and India having to cope with the largest mass poisoning from arsenic. The scale of the problem in terms of population exposed to high arsenic concentration is greatest in Bangladesh with 35 to 77 million i.e., around 28-62 percent of the total population of 125 million, might be at risk because they consume arsenic contaminated domestic water (Alam 2000, Smith *et al*. 2000). The study by Chakraborti *et al*. 2002 in the neighbouring districts of the state of West Bengal indicates that more than 6 million people from nine affected districts (approximately with a total population of 50 million) of 18 total districts (with a total population of 80 million) are drinking water containing ≥0.05 mg/L arsenic, and more than 300,000 people may have visible arsenical skin lesions. In retrospect, the first case of arsenicosis was recognized in West Bengal in 1980s (Chakraborty and Saha 1987, Garai *et al*. 1984, Saha 1984) but widespread contamination was not defined until 1995. Over the last 15 years, as of July 2002, researchers at the School of Environmental Studies (SOES), Kolkata, have analyzed more than 125,000 water samples and more than 30,000 urine/hair/nail/skin scale samples, screened approximately 100,000 people in West Bengal for arsenical skin lesions, and registered 8,500 people with arsenical skin lesions from 255 affected villages out of 306 screened.

Skin lesions due to arsenic toxicity have been proposed as useful indicators of risk for subsequent development of internal cancer as they represent a significant health problem not only because of the physical discomfort they cause but also the social stigma attached to the affected subjects. The epidemiological studies have shown evidence of arsenical dermatosis among nearly 92 percent of the population exposed to arsenic in the concentration of 0.20-2.0 mg/L in contrast to about six percent of the population with less than 0.05 mg/L in drinking water (Chakraborti *et al*. 2003). The prevalence of arsenicosis was higher among males than females (Khan *et al*. 1997, Tondel *et al*. 1999, Watanabe *et al*. 2001). However, the findings contradict with the results of another study conducted by Anwar (2002) where males were 41 percent and females were 59 percent among the cases. Increasing number of countries in Asia are now identifying arsenic contamination of groundwater (including Bangladesh, China, Cambodia, Laos, Myanmar, Nepal, Pakistan, Thailand and Taiwan). In a recent evaluation of data collected by the Department of Public Health and Engineering (DPHE)-UNICEF arsenic mitigation programmes, Rosenboom *et al*. (2004) found a prevalence rate of arsenicosis of 0.78 per 1000 population exposed to elevated arsenic (>0.05 mg/L) in 15 heavily affected Upazilas in Bangladesh. The authors concluded that data were difficult to interpret and that exposure had been relatively short and therefore the number of cases could increase.

However knowledge about the full health effects of arsenic is still incomplete. The social implications of this health problem and its impact on people's livelihood are yet to be adequately studied (GoWB 2004). Ignorant villagers mistakenly suspect the skin manifestations as those of leprosy and therefore avoid the person (Das *et al*. 1996, PHED 2002). Popular belief is that skin lesions and pigmentation changes caused by arsenic are ailments easily transmittable by contact. The stigma is such that the affected individuals are shunned by community and kins alike. At times even the domestic haven is denied to some, with the disruption of family life being a typical outcome (Hassan *et al*. 2005).

Prior studies on the occurrence of arsenic-induced skin lesions are mainly based on ecologic data, hospital-based studies relying on small number of cases or self-reported samples with very limited scientific studies examining the gender differentials in prevalence of arsenic symptoms, their exposure levels, dose and latency associated with the occurrence of skin lesions.

Objectives

With this background, the present paper tries to examine the gender differentials in arsenic-specific morbidities along with dose-response relationship based on a comparatively large dataset. It also tries to explore the social impacts of arsenic poisoning on people's daily lives, especially their interaction and intimacy with their immediate kins, friends and neighbours.

Data and methods

A cross-sectional case-control study was conducted in Murshidabad district, one of the arsenic affected districts of West Bengal. Among the total 26 blocks of Murshidabad district, 19 are arsenic affected according to the data of the Public Health and Engineering Department (2004). Since the level of arsenic contamination varies greatly within a district, all these 19 blocks were ranked according to their mean level of arsenic concentration after which they were divided into four quartiles. From each quartile one block was selected randomly. From the four selected blocks, eight villages, two from each block were chosen as case villages for the present study. In each block the villages were ranked according to the mean arsenic concentration provided by the PHED to the villages by arsenic concentration level in the tubewells. Two villages were chosen randomly, one from above the 50 percentile value and one below it. From the remaining seven blocks which are not affected by arsenic (here treated as control villages), two blocks were chosen purposively from which four villages, two from each block were again selected purposively. In all, 12 villages were selected for this study, eight from case and four from control villages respectively. The target population of this study was individual households within selected villages. Prior to the selection of the respondents from each of the selected case and control villages, PHED tested tubewells were identified according to the landmarks provided for the same. A quick field survey was conducted to verify the list. The list contained few errors and these errors were corrected before randomly drawing five tubewells each from case and control villages. The reason behind choosing five tubewells was purely based on the logic that we wanted to restrict our sample size to about 360 households (for coverage purpose) and also in the study district, approximately 35 persons (about six households) depend on a single tubewell for water. In all, the sample size consisted of 360 households, 240 and 120 for case and control villages respectively. Both quantitative and qualitative methods have been used for the purpose of data collection. A semi-structured interview schedule was used to collect quantitative information from the respondents. Among the qualitative tools, the study utilized participatory rural appraisal, in-depth interviews, and focus-group discussions (FGDs) to educe people's understanding of the impact of arsenic poisoning on certain social issues, their lives and subsequent coping strategies.

Summary of findings

Skin lesions due to chronic arsenic toxicity have been found in almost one-third of the study population with a history of exposure of more than 15 years. The age-adjusted prevalence of skin lesions was found to be strongly related to arsenic concentrations in water, rising from zero in the lowest exposure category (≤0.05 mg/L) to 16.3 per 100 for females consuming water with arsenic levels above 0.26001 mg/L. Among males, the age-adjusted prevalence of skin lesions increased from 6.7 per 100 in the lowest level to 44.3 per 100 in the highest category. The prevalence rate shows an increasing trend for both the sexes in accordance with progressive higher levels of arsenic concentration and increasing age. A few cases with skin manifestations were found in the control villages (7 per 100 males) with arsenic level in drinking water below the permissible limit (≤0.05 mg/L), which emphasizes the fact that the national standard needs to be amended and brought down to the WHO standard of 0.01 mg/L. Higher prevalence of dermal lesions in case of males in all exposure categories indicate that males are more susceptible to get the disease. The study also shows clear exposure-response relationships between water arsenic levels and the prevalence of skin lesions.

The study found gaps in knowledge and awareness of this problem between patients of affected villages and unaffected individuals. These differences in experiences and understanding reveal a picture of social hazard faced by arsenic-affected people, driven by isolation, social rejection and damage to social bonds. The issues are very much gender-specific as the socio-economic and cultural context are distinctly different for males and females in rural areas of the district. Although medical treatment is an expensive adaptation, some patients do seek it at the last stages and the choice is mostly for pluralistic health care services. Findings suggest that morbidity issues can be addressed effectively only when the state recognizes early detection and prompt treatment. The task ahead is not only to provide safe drinking water for all and health care services for the sick but also to narrow down the gap in knowledge among the inhabitants.